PRELIMINARY RELEASE

MODEL 70B CRATE CONTROLLER TYPE A-1
MODEL 71B CRATE CONTROLLER TYPE A-2

The Model 70 A is being replaced with an improved crate controller series which includes a type A-1 and A-2 crate controller.

The new Model 70B Crate Controller Type A-1 is similiar in performance to the Model 70A, but includes many improved mechanical features. The two circuit boards separate via a board to board connector for ease of servicing. The Hughes connectors and associated harness can be easily detached, and removed if required. This feature allows changing of the Hughes connector harness in the event of damaged pins without the necessity of taking the entire unit out of service. The optional user selectable features of Fast Read and Hold may now be selected by a P.C. board switch which is accessable without removing any covers.

The Model 71B Crate Controller Type A-2 contains all the features of the 70B controller above but also provides all the A-2 features including the rear auxiliary control bus connector, request grant and auxiliary control lockout features as described in IEEE STD 675-1979.

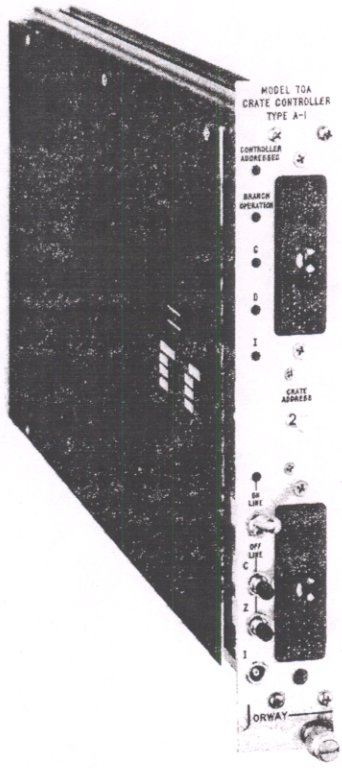
In addition to all the mandatory features required in the A-2 controller, the following options are available in the Model 71B:

Option 1, Auxiliary Controller: This option provides a set of rear panel switches which select operation as either a master or auxiliary controller. With this option, multiple parallel controllers can operate in the same crate, i.e. Two 71B's, one as an auxiliary controller or one 71B as an auxiliary controller and Serial Crate Controller Type L-2 as master.

Option 2, Mail Box Memory: This option provides a 24 bit read/write memory which is addressable via either the dataway or the Branch Highway. Common usage for this register would be to pass status words between two or more computers having acess to the same dataway. Down loading of data between two processors can also be accomplished with the mail box memory. Associated with this option is a LAM source which can be set via the Branch Highway or Dataway. This feature allows the 71B Controller to generate LAMs directly for the purpose of interrupting another processor.

JORWAY

MODEL 70A
CRATE CONTROLLER TYPE A-1



The Jorway Model 70A is a Type A-1 Crate Controller offering premium performance and a number of useful additional features at a cost competitive with less versatile units currently available. While allowing new systems to implement the latest Camac innovations, it also may be used in older systems with which it is entirely compatible. The Model 70A features:

- FULLY CONFORMS TO CAMAC SPECIFICATIONS – Meets all requirements for Type A-1 Controllers.
- HIGH IMPEDANCE BRANCH INPUTS – Minimal loading, cleaner signals.
- CRATE ADDRESS IDENTIFICATION – Automatically prevents duplicate crate address selection.
- PRECISION TIMING – Insures optimum performance.
- SOLID STATE INDICATORS – Long life LED's provide visual controller status information.
- ADDITIONAL MODES – User activated "Hold" and "Fast Read" for added versatility.
- RIGID QUALITY CONTROL – All units thoroughly tested and run in.

APPLICATION

The Jorway Model 70A Type A-1 Crate Controller provides a means of interfacing the Dataway of a Camac crate and a standard Branch Highway which permits the expansion of the Camac concept to larger multicrate (Branch) systems. Using this approach, up to seven crates, each utilizing a Type A-1 controller, can be connected together and interfaced, in turn, to a computer or other device capable of exercizing control over the entire system. All Type A-1 Crate Controllers must meet the requirements of EUR4100e and EUR4600e specifications. The Jorway Model 70A not only fully conforms to the mandatory provisions of the latest revisions[1,2] of both of these specifications, but also includes many additional features making it a more useful and versatile instrument.

GENERAL DESCRIPTION

The Model 70A is housed in a double width Camac module which occupies the control station and adjacent normal station in the crate, thus having access to all Dataway lines. Communication with the Branch Highway is via a pair of multipin connectors mounted on the front panel. These two connectors are internally bridged to provide continuity of the Branch Highway through the controller, permitting all units to be connected in a daisy chain manner. In addition to its normal ON LINE operating mode, the controller has an OFF LINE mode which may be selected by a front panel switch. In this mode the unit is effectively disconnected from the Branch, while remaining physically connected. Two front panel push buttons allow manual activation of Dataway Clear and Initialize in the OFF LINE mode only. Assignment of a CRATE ADDRESS to which the controller will respond, is accomplished by an internal switch with visual indication of the selected address on the front panel which meets the requirements of the specification. This seven position thumbwheel switch is easily accessible from the side of the module, and may be set without the need for any tools. Several front panel indicator lights are included which should prove valuable during normal operation, and especially as an aid in trouble shooting and debugging of both hardware and software. Dataway INHIBIT may be activated via a Lemo connector which allows an external signal to be applied.

The Branch Highway consists of sixty five (65) signal lines and individual return lines, plus two cable shield grounding conductors. Some branch lines, namely: BF, BA, BQ, BX, and BZ correspond to similar Dataway lines, F,A,Q,X, and Z, respectively. The five BN's are binary coded lines which the Model 70A decodes, producing twenty three (23) individual Station Number lines and several additional N addresses used internally. The twenty four (24) branch data lines (BRW) are bidirectional in nature, and correspond to the Dataway Read (R) or Write (W) lines depending upon the operation. Unique to the Branch Highway are the Branch timing (BTA and BTB), Branch Crate Address (BCR), Branch Graded-L request (BG), and Branch demand (BD) lines. Other Dataway lines have no similar Branch Highway lines but are activated during various branch operations. Command signals and data are gated onto the crate Dataway only during an operation addressed to that specific crate. In addition, gating is provided which gates Write data onto the Dataway Write lines only during Write operations, and accepts Read data only during Read operations. This keeps the Dataway Write lines clear of data during Read operations resulting in lower Dataway noise levels. All Dataway lines except the L lines, have pull up current sources in accordance with EUR4100e. Pull ups for the L lines are provided on the GL lines as per EUR4600e. Branch output lines are driven from open collector transistors capable of sinking more than the required current at a low saturation voltage. Very high input impedance on all branch input lines results in loading far less than the maximum permitted. The Model 70A

thereby has minimal effect on Branch Highway impedance, which contributes to cleaner signals on these lines. High input impedance is maintained with crate power off. All Branch Highway lines must be terminated at the end of the chain and pull up current sources provided. Termination units are available for this purpose.

In general, there are two modes in which the controller operates in conjunction with the Branch Highway: "Command" mode, in which commands are executed and data is exchanged between the Branch Driver and Crates, and "Graded-L" mode, in which requests for attention from modules may be identified. The state of the Branch Highway Graded-L request line (BG) selects the mode for each branch operation.

When in Command mode, the Branch Driver issues "Commands" which are instructions addressed to one or more crates. An On Line, addressed controller accepts the command, which includes station number, subaddress, and function information, and generates appropriate Dataway signals necessary to perform the operation. In addition, data may be transferred from the Branch Driver to addressed modules during Write operations and in the reverse direction during Read operations. The Model 70A is also capable of recognizing and implementing a total of eleven different commands, each performing a specific operation within the controller itself. Multi-station commands to preselected addresses may be implemented using the internal twenty three (23) bit Station Number Register (SNR) which may be loaded on command from the branch data lines (BRW). Using code N(24) all station numbers corresponding to the data stored in the SNR are addressed. Additionally, code N(26) addresses all stations simultaneously.

In the Graded-L mode (BG = 1) all crates are simultaneously addressed, however, no other commands are issued. On line controllers respond by presenting their Graded-L signals to the Branch Highway data lines. These signals are combined to form a composite data word representing up to twenty four (24) requests for attention. Graded-L data is derived from the Dataway L lines which may be selected, rearranged, or otherwise processed by an external, optional LOOK AT ME GRADER (LAG). A connector on the rear panel of the Model 70A is used to interconnect the LAG unit and the controller. If a LAG is not needed, L lines are simply connected to GL lines (in rearranged priority, if desired) by wiring at the rear of a mating LAG connector.

The Model 70A continuously monitors all Graded-L lines, and a Branch Demand is generated if a Look at Me signal is detected. This merely indicates the presence of one or more demands without identifying the source. The Branch Demand signal may be used as a rapid computer interrupt, typically initiating a program to search for, identify and service the demand. A front panel indicator is illuminated whenever a demand is present. Further examination of Look at Me requests from individual crates may be made by the execution of a "Read Graded-L" command addressed to a particular controller in a command mode operation.

All operations in both Command and Graded-L modes are accomplished through the use of a "handshake" method of dialogue between the controller and branch driver. This automatically adjusts the timing to compensate for differences in signal delays due to cable lengths and controller performance. The handshake is controlled by the branch timing signals. A common timing signal (BTA) is generated by the branch driver, and individual timing signals (BTB1-7), are generated by the controllers. BTA initiates an operation, and addressed controllers take action to execute the command or Graded-L request. Each controller responds on its BTB line indicating that it has established data on, or ready to accept data from the Branch Highway as required by the command. The branch driver, accepting or transmitting data then removes the BTA signal, after which the controller, completes the operation and returns its BTB line to the original state. Each on line controller generates a logic "1" on its BTB line when unaddressed, while BTB lines associated with absent or off line controllers remain at logic "0". This enables the branch driver to recognize which crates are present and on line so that nonexistent crates are not addressed in command mode operations and that all on line crates are addressed in Graded-L mode. Since a branch is not in a valid operating state if more than one crate in the system has the same address, the Model 70A incorporates circuitry to guard against such a possibility. If a Model 70A is switched to a crate address which is already occupied, the controller will revert to the off line state and remain so until either the other controller is switched to a different address (or off line), or another valid address is selected. This feature is particularly useful when a branch has crates in remote locations from each other, and will prevent interference to an operating system if an incorrect address is chosen.

While the basic timing requirements are defined by the Camac specifications, considerable latitude is permitted and in some cases the timing is either not specified, or not clear and open to interpretation. The Model 70A has been designed using "CERN Preferred Values"[3] as a guideline which sets tighter tolerances on the timing within the broader Camac specifications. This results in a controller capable of operating with optimum performance and small variations from unit to unit. The Model 70A features a precision clock generator which assures accurately timed steps throughout each timing sequence. The clock is started and stopped as required; no time being lost due to having to synchronize the clock to branch signals as would be necessary with a gated free running oscillator. Branch operations at the maximum rate permitted are thus achieved.

OPTIONAL FEATURES

Two additional modes of operation of the Model 70A are included, "Hold" and "Fast Read". These, although they may not entirely conform to Camac rules, nevertheless may, under certain circumstances, prove advantageous.

Both the "Hold" and "Fast Read" are optional in that they need to be activated by the user by the addition of simple jumper wires on the circuit board. These are normally not in place when the controller is supplied, to avoid possible conflicting usage of the P2 and BV4 lines. When activated, normal operation of the controller will not be affected as long as a logic 1 is not applied to the Hold and Fast Read lines.

The "Hold" feature allows modules which are unable to execute a command within the time limit imposed by a normal Camac cycle, to extend (hold) the cycle for such time as may be necessary. A handshake between the module and controller is established through the use of Free Bus Line P2. When the controller initiates a cycle, the module responds on the P2 line if a hold is required. The controller then holds the cycle at a point just prior to the generation of Dataway S1 and Branch Highway $\overline{\text{BTB}}$ until the module removes its hold signal. The cycle then proceeds in a normal manner.

The "Fast Read" mode may be used when only Read operations are required. During a Read operation data is established on the Branch Highway and accepted by the Branch Driver which signals its acceptance by returning the BTA line to logic 0. In effect, the Read transfer has been accomplished at this time, however, the controller must still complete the rest of its cycle (generation of S2, etc.) which in this case is unnecessary. The Fast Read mode provides a "short cycle" which is terminated as soon as the Branch Driver signals its acceptance of data. This reduces the time for a Dataway Read cycle to approximately .5μs as opposed to a normal cycle of about 1μs, saving considerable time. The Fast Read mode is controlled from the Branch Driver

via the Branch Highway spare line, BV4. A logic 1 on this line produces a short cycle operation.

REFERENCES

1. Camac, A Modular System for Data Handling EURATOM report EUR4100e, USAEC TID-25875, (July 1972).
2. Camac, Organization of Multi-Crate Systems EURATOM report EUR4600e, USAEC TID-25876 (March 1972).
3. CERN-NP CAMAC Note 38-00 (December 1971).

SPECIFICATIONS MODEL 70A

CONTROLS AND INDICATORS

ON LINE-OFF LINE Switch	Selects On Line or Off Line Mode.
C Pushbutton (effective in Off Line only)	Generates Dataway cycle with C,S1,S2,B.
Z Pushbutton (effective in Off Line only)	Generates Dataway cycle with S1,S2,B, and Z.
	Sets I flip flop. (Dataway I will assume a maintained logic 1 state when controller is returned to the On Line mode.)
I Input (effective in On Line and Off Line)	Activates Dataway Inhibit line when Camac Logic 1 applied. Input load = 1 TTL input.
CRATE ADDRESS Switch	Assigns crate address to which controller will respond. Switch is set from side of module with visual indication on front panel.
ON LINE Indicator	Illuminated when controller is in On Line state.
CONTROLLER ADDRESSED Indicator	Illuminated during an operation addressed to controller. [N(28) + N(30)] (TA+TB)
BRANCH OPERATION Indicator	Illuminated during any operation initiated from the Branch Highway. (TA+TB+BZ)
G Indicator	Illuminated During a Graded-L operation. G(TA+TB)
D Indicator	Illuminated when one or more Look at Me demands (GL's) are present.
I Indicator	Illuminated wherever Dataway I is at a Logic 1.

NOTE: Controller Addressed, Branch Operation, and G Indications are stretched so short duration signals are visible.

BRANCH HIGHWAY SIGNALS

Inputs	BA,BF,BN,BCR,BRW,BZ,BTA,BV4
Threshold Voltage	+1.8v typical
Input Current	<+10μa typical @ 0.3v, +50μa typical @ 4.1v
Outputs	BQ,BX,BD,BTB,BRW
Logic 1 voltage	0.3v max. @ 133ma
Current sinking capability	133ma min.

DATAWAY SIGNALS

Inputs	R,Q,X,L,P2		
Threshold voltage	+1.1v typical		
Pull up capability	10.2ma max. @ 0.5v		
Current source	2.6ma max. @ +3.5v		
Outputs	W,A,F,B,Z,C,I	N	S1, S2
Current sinking capability @ 0.5v	39.4 max.	7.4 max.	56.0ma max.
Pull up capability @ 3.5v	2.6 max.	2.6 max.	12.6ma max.

COMMANDS IMPLEMENTED

ACTION	COMMAND	RESPONSE
1. Generate Dataway Z	N(28)A(8)F(26)	BQ = 0
2. Generate Dataway C	N(28)A(9)F(26)	BQ = 0
3. Read GL	N(30)A(0-7)F(0)	BQ = 1
4. Load SNR	N(30)A(8)F(16)·S1	BQ = 1
5. Remove Dataway I	N(30)A(9)F(24)·S1	BQ = 0
6. Set Dataway I	N(30)A(9)F(26)·S1+(Z·S2)	BQ = 0
7. Test Dataway I	N(30)A(9)F(27)	BQ = 1 if I = 1
8. Disable BD Output	N(30)A(10)F(24)·S1+(Z·S2)	BQ = 0
9. Enable BD Output	N(30)A(10)F(26)·S1	BQ = 0
10. Test BD Output Enabled	N(30)A(10)F(27)	BQ = 1 if BD enabled
11. Test Demands Present	N(30)A(11)F(27)	BQ = 1 if demands present

NOTE:

1. All above commands are accepted only in response to BTA. BX is generated for each.
2. A Dataway cycle is generated for Commands 1 and 2. Dataway C and Z present only during Dataway Cycle (TA + TB). Dataway I is set in response to Dataway generated Z·S2.
3. In addition to the above, N(24) addresses all station numbers stored in Station Number Register (SNR) and N(26) addresses all Station numbers simultaneously.

BRANCH HIGHWAY LINE USAGE

BCR 1-7	Crate Address (BCR_i) to which On Line controller responds. BCR_i = BCR line corresponding to selected crate address.
BTA	Initiates handshake and starts cycle in addressed crate. Internal TA is conditioned (integrated) approximately 100ns to suppress noise. TA = $BCR_i \cdot BTA$
BTB 1-7	On line, unaddressed controller has BTB_i line at logic 1, all other BTB lines at logic 0. Addressed controller generates internal TB at appropriate time in cycle. BTB_i = 0 generated in response to TB. All BTB lines in Off Line controllers are at Logic 0. BTB_i = BTB line corresponding to selected crate address. BTB lines have controlled transition times of approximately 100ns.
BRW 1-24	Data on BRW lines is gated onto corresponding Dataway W lines during write operations, F(16-23) (TA+TB). Data on Dataway R lines are gated onto corresponding BRW lines during read operations, F(0-7) (TA+TB).
BZ	Generates Dataway cycle with S1,S2,B, and Z. Sets Dataway I to maintained logic 1 state. BZ is integrated for approximately 3μs, and takes precedence over all other signals in the Branch, i.e., any cycle in progress is terminated, and a new BTA will not be accepted for the duration of BZ.
BG	When BG is present, a Graded-L operation is initiated in response to BTA. Internal G = $BCR_i \cdot BG$.
BA1,2,4,8	Gated onto corresponding Dataway A lines during controller cycle, (TA+TB).
BF1,2,4,8,16	Gated onto corresponding Dataway F lines during controller cycle, (TA+TB).
BN1,2,4,8,16	Decoded by controller and gated onto appropriate Dataway N line during command mode controller cycle, $\overline{G}$ (TA+TB).
BQ	Dataway Q, and Q signals generated by the controller are gated onto the BQ line during a controller cycle, (TA+TB).
BX	Dataway X, and X signals generated by the controller are gated onto the BX line during a controller cycle, (TA+TB).
BD	BD is generated when an internal demand (D) signal is present (as a result of one or more GL lines at logic 1) and BD is enabled. BD has controlled transition time of approximately 100ns.
BV4	Controller generates a "Fast Read" short cycle in response to BTA when BV4 is at logic 1. BV4 must be activated by user by addition of a jumper wire on circuit board.
BSC	Cable shield grounding conductors(2). Grounded internally by means of jumpers which may be removed if desired.

TIMING

Command Mode timing cycle	1450ns typical
Graded-L mode timing cycle	1050ns typical
Dataway cycle	1.1μs typical

MECHANICAL — Double width Camac module with metal side shields.

CONNECTORS — Branch Highway (2) Hughes WSS0132S00BN000 or equivalent.
LAG-Cannon 2DB52P

TEMPERATURE — 0° to 60° C

POWER REQUIREMENTS

+6v	2500ma maximum	1750 ma standby
-6v	110ma maximum	150 ma standby

NOTE: Maximum current requirements are worst case values. +6v and -6v worst case do not exist at same time. Standby currents occur with no operation in progress. Actual currents will be between standby and maximum depending upon type of operation and duty cycle. Maximum Power is less than 16 watts under all conditions.

● Also Available . . . MODEL 50C BRANCH TERMINATION UNIT

The Jorway Model 50C Branch Termination Unit is designed to be used in systems employing the standard Branch Highway and Type A or A-1 Crate Controllers. An integral cable assembly allows the unit to be easily connected to the Branch Highway without the need for additional cables. The Model 50C terminates and provides current sources for the sixty five (65) active branch lines. Additionally the two cable shield lines (BSC) are internally grounded. The Model 50C meets all of the applicable requirements of EUR4100e and EUR4600e.

SPECIFICATIONS

Terminating Impedance	100 ohms
Open Circuit Voltage	+ 4.1v
Short Circuit Current	40ma
Power Requirements	+6v @ 2600 ma max.
Mechanical	Double width Camac module with metal side shields.
Cable Length	1.5 ft.

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